

An alternative approach to prescribing sternal precautions after median sternotomy, “Keep Your Move in the Tube”

Jenny Adams, PhD, Ana Lotshaw, PT, PhD, CCS, Emelia Exum, PT, DPT, Mark Campbell, BSc, MSc, Cathy B. Spranger, DrPH, Jim Beveridge, RN, PCCN, Shawn Baker, PT, DPT, MS, Stephanie McCray, RN, Tim Bilbrey, MBA, Tiffany Shock, BS, Anne Lawrence, RN, Baron L. Hamman, MD, and Jeffrey M. Schussler, MD

Traditional sternal precautions, given to sternotomy patients as part of their discharge education, are intended to help prevent sternal wound complications. They vary widely but generally include arbitrary load and time restrictions (lifting no more than a specified weight for up to 12 weeks) and may prohibit common shoulder joint and shoulder girdle movements. Having observed the negative effects of restrictive sternal precautions for many years, our research team performed a series of studies that measured the forces exerted during various common activities and their relationship to the sternum. The results, though informative, led us to realize that the goal of identifying “the” appropriate load restriction to prescribe for sternotomy patients was futile. The alternative approach that we introduce applies standard kinesiological principles and teaches patients how to perform load-bearing movements in a way that avoids excessive stress to the sternum.

Coronary artery bypass grafting (CABG) and other procedures involving median sternotomy carry the risk of sternal wound complications that can lead to increased morbidity, reduced quality of life, prolonged or repeated hospitalizations, increased health care costs, and, for serious cases, mortality rates of 15% to 40% (1–3). Because the consequences of sternal complications can be grave, sternotomy patients require educational guidance before being discharged from the hospital.

Authors of the first discharge education materials focused on restricting the loads patients could lift for specific time periods that were considered appropriate for sternal healing (4, 5). The resulting sternal precautions likely stemmed from expert opinion or were based on anecdotal rather than direct evidence (6) and, consequently, vary widely among hospitals and rehabilitation centers around the world. In general, sternal precautions are very restrictive. Beyond imposing arbitrary load restrictions, they often prohibit common shoulder joint and shoulder girdle movements, including shoulder flexion/extension and abduction/adduction, along with scapular retraction/protraction, elevation/depression, and upward/downward rotation. Specific examples from the USA and abroad include lifting no more than a specified weight (usually between 5 and 20 pounds) for up to 12 weeks (7–10); not pushing up when rising from sitting to standing (11); and performing only pain-free bilateral

arm movements (horizontal, backwards, or over the shoulder) (1, 12).

THE CASE FOR CHANGE

Sternal precautions are intended to help protect patients after median sternotomy, but instead they may inadvertently impede recovery. A restriction such as “don’t lift more than 5 pounds” can reinforce fear of activity (13), leading to the substantial muscle atrophy that occurs during short-term disuse (14). Resistance exercise training is necessary for regaining muscle mass lost during a period of disuse; therefore, “don’t lift more than 5 pounds” is the *opposite* of what patients need to hear. Physical activity restrictions can also delay or prevent a return to work by patients whose physically demanding jobs require them to handle loads and exert force in excess of current recommendations (15). When patients cannot resume job duties, they and their families suffer (16).

Worldwide, median sternotomies are performed during an estimated 800,000 CABG procedures (17), 5000 transplants (18), and an indeterminate number of cardiac valve surgeries each year, so the potential scope of problems arising from the ongoing use of restrictive sternal precautions is sobering. With a goal of identifying “the” appropriate load restriction to prescribe for sternotomy patients, we began a series of cardiovascular research studies in the mid-1990s that measured the forces exerted during various common activities and their relationship to the sternum (7, 19–21):

1. We conducted 6 sessions of a simulated lawn-mowing protocol that matched the push and pull forces (36 and 39 force/pounds, respectively) of mowing outdoors, and the activity did not negatively affect the sternal incision, electrocardiogram findings, blood pressure, or heart rate of 13 male sternotomy patients (3 to 7 weeks post-CABG).

From Baylor Heart and Vascular Hospital (Adams, McCray, Bilbrey, Shock, Lawrence, Schussler); Baylor University Medical Center at Dallas (Lotshaw, Exum, Beveridge, Hamman, Schussler); Baylor Institute for Rehabilitation (Baker); Darwen Leisure Centre, Darwen, UK (Campbell); and Seton Medical Center Austin, Austin, Texas (Spranger).

Corresponding author: Jenny Adams, PhD, Cardiac Rehabilitation Department, Baylor Heart and Vascular Hospital, 411 North Washington, Suite 3100, Dallas, TX 75246 (e-mail: jennya@BaylorHealth.edu).

2. We measured the force required for common load-bearing activities, such as pulling out a full dishwasher rack (5 pounds), removing a gallon of milk from a refrigerator (10 pounds), and pushing a glass door to exit the hospital (22 pounds).
3. We found that the force across the sternum during a cough (regularly tolerated by sternotomy patients) was 60 pounds, or greater than the force exerted while lifting two 20-lb weights simultaneously.
4. We compared the force across the sternum during a sneeze with the force exerted during a bench press exercise and found that a sneeze exerted a force of 90 pounds and was not significantly different than the force exerted while lifting 70% of one-repetition maximum.

Because sternotomy patients commonly endure coughing and sneezing without incident during recovery, these research findings may seem to imply that lifting loads in the range of 60 to 90 pounds is safe. This is definitely not the case, as sternal wound dehiscence from intense coughing has been reported (22), and sneezing may also pose a risk (1). This knowledge, coupled with the fact that sternal complications have been linked to risk factors such as obesity, diabetes mellitus, and smoking (23), led us to realize that our research efforts to determine a single ideal load restriction were futile. As a result, our team pursued an alternative approach to sternal precautions.

INTRODUCING *KEEP YOUR MOVE IN THE TUBE*

We moved away from load and time restrictions and instead used standard kinesiological principles to develop this new approach. Because *Keep Your Move in the Tube* is based on the ergonomics that shorten the length of the outstretched arm (lever arm reduction), it enables patients to perform previously contraindicated movements.

The first step in applying this approach is to explain to patients in layman's terms what happened to their sternum during surgery, using an illustration of the attachments of the pectoralis major on the sternum, the humerus, and the clavicle (*Figure 1*).

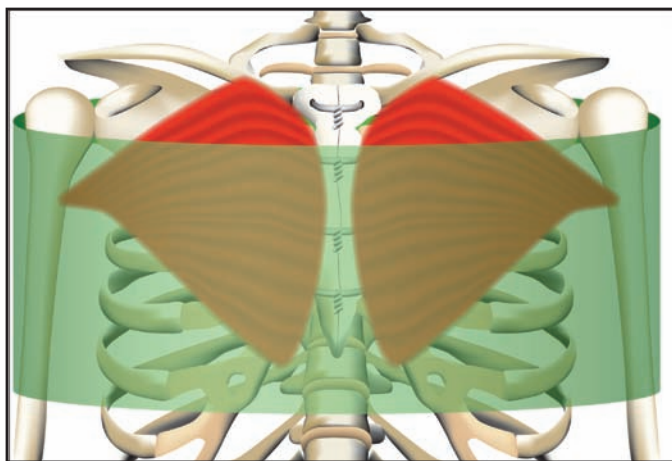


Figure 1. Illustration used to teach patients about their sternotomy, the attachments of the pectoralis major, and the imaginary truncal tube that is the basis of the *Keep Your Move in the Tube* approach.

This brief anatomy lesson provides the foundation for understanding the concept behind the *Keep Your Move in the Tube* graphic (*Figure 2*): By keeping their upper arms close to their body, as if they were inside an imaginary truncal tube, patients can modify load-bearing movements and thus avoid excessive stress to the sternum. More specifically, limiting the movement of the humerus minimizes the lateral pull on the sternum and decreases the leverage of the hand and forearm during load-bearing actions such as rolling a wheelchair, opening a heavy door, or lifting a toolbox. The graphic's simple drawings show movements that are "in the tube" (green) versus "out of the tube" (red). These color-coded differences are easy to comprehend, and the overall format overcomes barriers related to language preference and reading ability.

In addition to information on basic movement patterns, sternotomy patients need instruction on basic mobility skills. Immediately after surgery, they often find it painful to sit up from a supine position or to stand up from a chair. The left side of the *Keep Your Move in the Tube* graphic contains visual tips for staying "in the tube" while performing commonly recommended techniques for getting out of bed, such as side-lying and placing one or both hands in front of the body, leaning forward, and pushing up to a sitting position (11); log rolling (24); and/or the elbow method (leg rolling and counterweighting) (1). However, for non-load-bearing activities such as personal hygiene, patients are allowed to reach "out of the tube" (above the head, out to the side, or behind the back).

With traditional sternal precautions, patients in the hospital are advised not to use their arms to push up during bed mobility and transfers. As a consequence, they often require assistance from the nursing staff, the therapy team, or family members to complete these movements. Toward the end of the hospital stay, the therapy team's assessment of mobility status is a major determinant of whether a patient needs rehabilitative care after being discharged. Instead of going home with a physician referral for outpatient cardiac rehabilitation, patients who have no available friends or family to help with mobility may be sent to an inpatient rehabilitation facility. *Keep Your Move in the Tube*, by contrast, enables patients to use their arms and thus perform bed mobility and transfers more efficiently, which may increase the likelihood that they will be discharged to their home.

Because individual patient healing time can be affected by factors such as age, underlying medical conditions, nutritional status, medications, and use of tobacco, our educational approach does not impose time limits during which loads are restricted. We allow patients to resume their normal load-bearing activities at their own pace, within pain-free limits, as long as they stay "in the tube." With an emphasis on partnership and creative problem solving, we also suggest ways that family members can help the patient during recovery without being overprotective or overly controlling (e.g., using the correct "in the tube" movements, the patient can mow the grass, but only after a family member pulls the cord to start the mower's engine).

Keep Your Move in the Tube™

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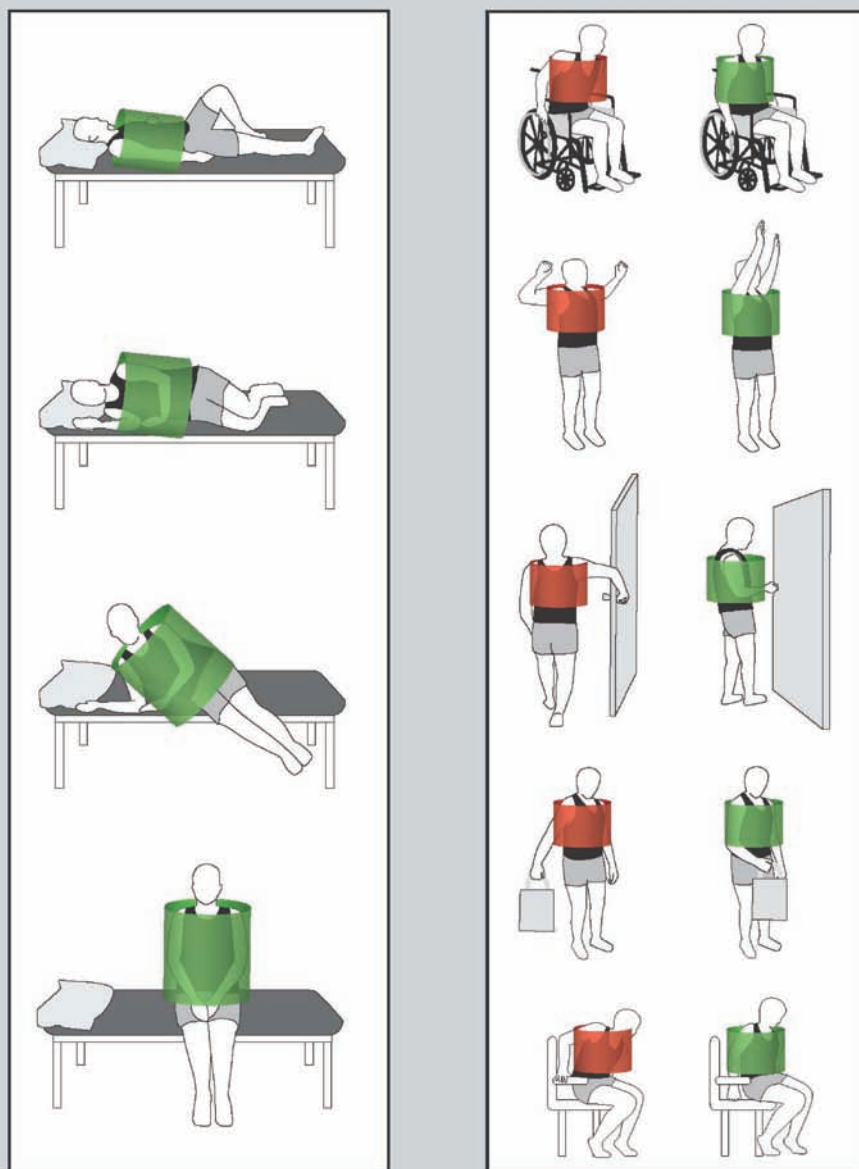


Figure 2. *Keep Your Move in the Tube* graphic used to teach load-bearing upper extremity movements to patients recovering from median sternotomy. A teaching script is available from the corresponding author or from http://www.baylorhealth.edu/Documents/BUMC%20Proceedings/2016_Vol_29/No_1/29_1_Teaching_Script.pdf.

IMPLEMENTATION

Several essential elements have emerged during the implementation of *Keep Your Move in the Tube*. First, the approval of cardiologists and cardiothoracic surgeons has been crucial, along with acceptance by nursing staff members. Furthermore, the ongoing process of including nurses from the intensive care unit is necessary to ensure that patients receive consistent educational advice throughout their hospital stay. Finally, our success to date can be attributed to a positive collaboration between physical therapists, occupational therapists, and cardiac rehabilitation specialists.

At this writing, *Keep Your Move in the Tube* is being used at four facilities in Texas. Three are within Baylor Scott & White Health: Baylor Institute for Rehabilitation, where it has replaced traditional sternal precautions in physician order sets; Baylor Heart and Vascular Hospital, where it is included in presurgical educational materials; and Baylor University Medical Center at Dallas, where it has been added to the therapy team's mobility criteria. The fourth is Seton Medical Center Austin, where it is used in phase I cardiac rehabilitation. As a multidisciplinary team, we are united in the belief that *Keep Your Move in the Tube* encourages active living after sternotomy and thus offers a useful alternative to traditional sternal precautions.

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